

Amendments to the Specification

On page 3, please replace the paragraph beginning on line 15 and ending on line 18 with the following amended paragraph:

Currently, poly(tetrafluoroethylene) (PTFE), Polyethylene (PE), Polypropylene (PP) and poly(vinylidene fluoride) (PVDF) are the most popular and available hydrophobic membrane materials. Poly(ethylene-chlorotrifluoroethylene) (~~Halaf~~ sold under the trademark HALAR) is another hydrophobic material showing promise as a membrane polymeric material.

On page 4, please replace the paragraph beginning on line 18 and ending on line 25 with the following amended paragraph:

The present applicants have found that, in certain cases, Poly (VinylMethylEther) (PVME) can be used to modify, and in particular, reduce, the hydrophobicity of certain hydrophobic membranes. The PVME can be incorporated either by means of post-treatment, such as by soaking hollow-fibre membranes in a solution of PVME, or by incorporating PVME into the dope solution for forming the membrane. Either approach could be demonstrated for a variety of reaction types, including different types of membranes such as Poly(vinylidene fluoride) (PVDF), Poly(ethylene-chlorotrifluoroethylene) (~~Halaf~~ sold under the trademark HALAR) and Poly(propylene) (PP).

On page 5, please replace the paragraph beginning on line 1 and ending on line 2 with the following amended paragraph:

PVME as a post-treatment was found to make PVDF and ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes hydrophilic, although the treatment was also useful on PP membranes.

On page 5, please replace the paragraph beginning on line 16 and ending on line 17 with the following amended paragraph:

In another aspect, the invention provides a hydrophilic polymeric membrane including one or more of ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) sold under the trademark HALAR, PVDF or PP.

On page 5, please replace the paragraph beginning on line 18 and ending on line 20 with the following amended paragraph:

In yet another aspect, the invention provides a hydrophilic polymeric membrane having a highly asymmetric structure, preferably formed from one or more of ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) sold under the trademark HALAR, PVDF or PP.

On page 8, please replace the paragraph beginning on line 1 and ending on line 4 with the following amended paragraph:

For preference, the polymeric material is poly(vinylidene fluoride) (PVDF), poly(ethylene-chlorotrifluoroethylene) (~~Halaf~~) sold under the trademark HALAR and poly(propylene) (PP) or mixtures thereof. Poly(vinylidene fluoride) (PVDF) and poly(ethylene-chlorotrifluoroethylene) (~~Halaf~~) sold under the trademark HALAR are particularly preferred.

On page 9, please replace the paragraph beginning on line 21 and ending on page 22, line 5 with the following amended paragraph:

PVME was surprisingly found to be effective at hydrophilising otherwise hydrophobic PP, PVDF and ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes either by soaking the membrane as a post treatment or by

including the PVME as a hydrophilising agent incorporated in the membrane dope. Hydrophilisation can be achieved either by soaking the membranes in a solution of PVME in a suitable solvent, for example, ethanol or water, preferably at a level greater than 0.5wt%. PVDF and ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes in particular demonstrate long term stability with PVME adsorbed onto the surface, although PVME also appears to have good affinity with PP. Leaching tests show minimal leaching of PVME from the membranes after 10 days with the PVDF and ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) samples are all still hydrophilic after this period of time.

On page 11, please replace the paragraph beginning on line 19 and ending on line 22 with the following amended paragraph:

The post-treatment of a variety of membranes with a cross-linkable hydrophilising agent was investigated. PVDF, ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) and PP membranes were all tested. For the ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes, both MF (microfiltration) and UF (ultrafiltration) membranes were tested.

On page 12, please replace the paragraph beginning on line 9 and ending on line 12 with the following amended paragraph:

The general procedure for treating the pre-prepared ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes was more elaborate due to to glycerol-loaded pores which are present as a result of the method of production of ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes. The membrane was soaked in ethanol for 12hrs, followed by water for 15 minutes.

On page 12, please replace the paragraph beginning on line 22 and ending on page 13, line 2 with the following amended paragraph:

Wicking is said to have occurred ~~occurs~~ if a solution of dye is spontaneously absorbed into a fibre that is partially submerged vertically in such a solution and travels upwards above the solution meniscus. This can clearly be seen in strongly hydrophilic fibres (capillary action) but not in hydrophobic fibres. Wicking tests were not conducted with the ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) fibres, as an artificial result would arise as a result of the glycerol in the pores.

On page 15, please replace Table 3 with the following amended Table 3:

TABLE 3

~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) —
Wicking and Permeability results

Fibre Type	Halar <u>HALAR</u>	Halar <u>HALAR</u>	Halar <u>HALAR</u>	Halar <u>HALAR</u>
	MF	MF	UF	UE
Solution	Ethanol	2wt%	Ethanol	2wt%
Details	wet	PVME in Water	wet	PVME in Water
Treatment	5 mm	16 hr	<i>5 mm</i>	16 hr
Length				
Permeability	2039	1620	527	289
(LMH/bar)				

On page 15, please replace the paragraph beginning on line 13 and ending on line 15 with the following amended paragraph:

The permeability of Halar Poly(ethylene-chlorotrifluoroethylene) sold under the trademark HALAR is slightly reduced as a result of PVME treatment. Generally permeability measurements for ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) MF fibre range between 1500-2000LMH/bar, with ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) UF membranes varying between 200-600LMH/bar.

On page 16, please replace the paragraph beginning on line 1 and ending on line 6 with the following amended paragraph:

The results from the ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes are difficult to quantify with precision because it is believed that glycerol in the pores results in lower initial clean water permeabilities that slowly increase towards a fixed value as the glycerol is completely removed from the pores. This may explain why the ethanol washed fibres have a slightly 5 higher apparent permeability, since glycerol is more readily soluble in ethanol than in water.

On page 16, please replace the paragraph beginning on line 7 and ending on line 10 with the following amended paragraph:

~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) has a mildly polar structure not dissimilar to PVDF and the affinity between ~~Halar~~ HALAR and PVME replicate to a degree the interaction between PVME and PVDF. The results below give an indication of the permanency of the treatment of ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) membranes with PVME.

On page 17, please replace the paragraph beginning on line 3 and ending on line 5 with the following amended paragraph:

The dry standard appears at first to increase in PVME concentration initially, to a concentration that is above the sample soaked in 1wt% ethanolic PVME and the ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) sample.

On page 17, please replace the paragraph beginning on line 6 and ending on line 14 with the following amended paragraph:

An ethanol-wet standard and a dry standard were both used because there can be very small quantities of residual solvent in the PVDF membranes that are only slightly soluble in water and although very difficult to leach out entirely would nevertheless affect the UV-Vis readings. Washing with ethanol prior to UV-Vis analysis should remove any residual solvent from the membrane. This may explain why the PVDF samples appear to rise in PVME leach concentration or have a slightly higher steady-state value rather than the ethanol-wet sample. However, it is also possible that the PVME may bind more firmly to the ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) surface rather than the PVDF surface, from an aqueous solution.

On page 18, please replace Table 4 with the following amended Table 4:

TABLE 4

MEMBRANE PERMEABILITY BEFORE AND AFTER PVME TREATMENT

Description	Permeability Before	Permeability After	% Change
Ethanol washed Blank - PVDF	1542	984	-36.2
1 wt% PVME in Ethanol PVDF	1442	855	-40.7
1 wt% PVME in Water- PVDF	1505	307	-79.8
DryBlank-PVDF	1542a	741	-51.9
1 wt% PVME in Water – Halar HALAR	138	74	-46.4

On page 18, please replace the paragraph beginning on line 9 and ending on page 19, line 4 with the following amended paragraph:

DOPE ADDITION STUDIES

TIPS Membranes

PVME was added to standard TIPS PVDF or TIPS ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) (sold under the trademark HALAR) dope in proportions varying from 0 to 1 wt%. The TIPS extrusion was operated in a continuous process (although there is nothing to prohibit its use in batch processes if desired). For PVDF, PVME was dissolved into the solvent/non-solvent mixture of GTA and diethylene glycol, triethylene glycol or 1,4-butanediol. For ~~Halar~~ Poly(ethylene-chlorotrifluoroethylene) sold under the

trademark HALAR, PVME was simply dissolved in GTA. PVME is highly soluble in GTA but insoluble in more polar compounds like diethylene glycol, triethylene glycol and 1,4-butanediol.

On page 20, please replace Table 5 with the following amended Table 5:

TABLE 5 DETAILS OF TIPS MEMBRANES PREPARED WITH PVME IN DOPE

	0.1wt% PVME	0.2wt% PVME	0.5wt% PVME	1wt% PVME	0.5wt% PVME	1 wt%
Polymer Type	50/50 Solef 1015 -Kynar 461	50/50 Solef 1015 - Kynar 460	50/50 Solef 1015-Kynar 450	Solef 1015	HALAR <u>HALAR</u> 901	HALAR <u>HALAR</u> 901
Polymer Concentration (wt%)	24	24	24	18	18	18
Solvent-Non-solvent	GTA - Diethylene glycol	GTA-Diethylene glycol	GTA-Diethylene glycol	GTA-Diethylene glycol	GTA	GTA
Solv./Non-solv. Ratio (wt%)	40:60	40:60	45:55	40:60	100	100
Coating Solvent	Triacetin	Citroflex 2	Triacetin	Triacetin	GTA	GTA
Coating Non-solvent	Diethylene Glycol	Diethylene Glycol	Citroflex 2	Diethylene Glycol	-	-
Coating Solv./Non-solv. Ratio (wt%)	68:32	45:55	90:10	50:50	100	100
Quench Type	Water	Water	PEG 200	Water	Water	Water
Break Extension (%)	152	228	35	-	156	173
Break Force/unit area (N/mm ²)	5.1	7.08	2.98	-	5.94	5.59
Permeability (LMH/bar)	4838	1440	301	-	1367	707
Bubble Point	250	390	460	-	450	200
Fibre Wicking	Partially	Yes	Yes	Yes	-	-

On page 20, please replace the paragraph beginning on line 3 and ending on page 21, line 3 with the following amended paragraph:

The differences between the structures of the membranes, as observed by SEM for the samples with and without PVME are only minor for 0.1 and 0.2wt%. These can be seen in Figures 2 and 3. Slightly larger than average cells within the structure can be seen in the SEMs of samples that have been prepared with PVME. However at about 0.5wt% some immiscibility is apparent and there is some de-mixing occurring. At the 1 wt% level this de-mixing has become more extreme. In the case of PVDF, this is most likely due to the high proportion of non-solvent used in the dope mixture to extrude the membrane fibres. In the case of ~~Halaf~~ Poly(ethylene-chlorotrifluoroethylene) sold under the trademark HALAR, which can be seen in Figure 4, demixing is most likely due to immiscibility with the base polymer (HALAR) as there is no non-solvent present.